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The MODEL ENGINEER

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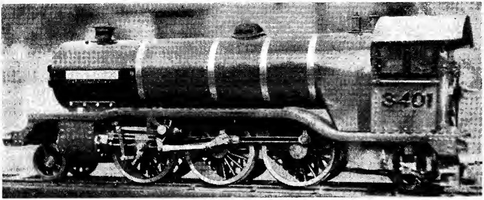
SMOKE RINGS

Our Cover Picture

THIS week we reproduce a photograph taken at a picturesque corner of the miniature railway which is now in operation at the Ruislip Lido, Middlesex. The gauge is the very unusual one of 12 in., due to the fact that the locomotive was built for this gauge, and to no particular scale. Older readers will probably recognise this engine when we remind them that it is a 4-4-2 type tender engine, built by Mr. George Flooks, of Watford; it was described and illustrated in THE MODEL ENGINEER for December 26th, 1935.

The Late Admiral Sir Reginald Bacon

IT is with deep regret that I record the passing of Admiral Sir Reginald Bacon, K.C.B., K.C.V.O., D.S.O., who died at his home at Romsey, on June 9th, aged 83. In addition to being an outstanding naval officer, Sir Reginald was an engineer of much distinction and a model engineer whose kindly appreciation for the work of others matched his own power of handicraft achievement. In his elaborate private workshop he was constantly engaged in experimental and constructive work, and at Model Engineer Exhibitions he received two awards for fine examples of his accurate and well-finished work. The first of these was for a scale model of a 15-in. howitzer of his own design, and the second, in a later year, for the rigging of an old-time sailing battleship. There is a story about this rigging achievement. At a previous exhibition, the Admiral had found occasion to criticise severely the rigging of some of the ship models in the competition section. "They don't know how to rig a ship," he said, "I'll show them." The following year he entered his battleship model, in full sail, perfectly rigged to the last turn of the last rope. A silver cup marked the high approval of the judges. The model had been rigged in the garden of the Admiral's winter home at Rapallo, in Italy, and Lady Bacon had patiently and most perfectly attended to the fine needlework called for in the preparation of the sails. At two of our exhibitions, Sir Reginald kindly offered a handsome silver cup for the best model entered by a lady, and on each occasion he personally examined the exhibits and allotted his prize. As showing his broad outlook on the demonstration of model-making skill, his cup in one year went to a farm wagon drawn by a most realistic team of horses, and in 1946 it was given for a steam locomotive. In 1938 he showed as a loan exhibit another example of his neat handicraft in the perfect rigging of a lovely little prisoner-of-war bone ship model. He received many honours during his distinguished naval career, and held many important posts, one of which was that of Inspecting Captain of the first submarines introduced into the British Navy in 1901. He was also Director of Naval Ordnance and Torpedoes in 1907. From 1922-1924 he was President of the Society of Model and Experimental Engineers, and was always most keenly interested in the welfare of that body. I had the privilege of



The Powell's " Bantam Cock " minus hand-rails

knowing him for many years, enjoying the sunshine of his kindly and genial personality, and admiring the versatility and depth of his practical mind and his sound judgment of both affairs and men. Lady Bacon invariably accompanied him on his visits to our exhibitions, keenly interested in everything which attracted her husband, and model engineers everywhere would, I am sure, wish to join me in tendering our profound sympathy in the great loss she and her daughter have sustained.

A Bethnal Green Society

A PROPOSAL is on foot to start a model engineering society in connection with the Bethnal Green Men's Institute. The Principal of the Institute, Mr. Harrison, is very interested in the idea, and I understand that a lathe, a drill, and a grinder are all ready to be installed when the right enthusiasts come along and join up. The purchase of materials can also be conveniently arranged for members. Here is a good opportunity for East London readers to get together, and those interested should make early contact with Mr. O. Smith, 29, Hitcham Road, Lea Bridge Road, Leyton, E.17, a model engineer of many years' standing, who is now busy on a 15-c.c. petrol engine to Mr. Westbury's design.

A Family Affair

THE illustration herewith shows a 3½ in. gauge 2-6-2 locomotive, " Bantam Cock," which was built by four people—Mr. T. Powell, of Eltham, and his sons Ronald, Peter and Ray. The engine was begun in May, 1945, and finished complete with its tender, in June, 1946. The drawings and description by " L.B.S.C.", published some time ago in our contemporary, *Mechanics*, were faithfully adhered to by Messrs. Powell, and the engine has proved to be a most successful performer on the track. It is not the first locomotive to be built by the Powell family; they already had a " Southern Maid " and a " Purley Grange " to their credit. The next will be " Juliet " ; so it is clear that father and sons are ardent followers of " L.B.S.C." Mr. Powell senior has been a reader of THE MODEL ENGINEER since the first issue, and he says he would rather go without a meal than miss a copy! Ronald, Peter and Ray are all keen model engineers and always ready to collaborate with their father in their workshop where there is a very good kit of tools.

Model Engineers and Police

THE Exeter and District Model Engineers' Society are staging an exhibition at the Police Gymnasium, Waterbeer Street, Exeter, from the 14th to 19th July, 1947. This is probably the only occasion a model engineering exhibition has been held on police premises—but there is rather a special reason for this. The Chief Constable, who is also the Hon. Secretary of the local Accident Council, is staging an ' Accident Prevention Week ' and he has kindly given his permission for the Society to use the gymnasium for the Exhibition on condition that the show is given an accident prevention ' twist ' and pass the persons visiting on to him after they have seen the models, so that they can be shown his Traffic Demonstration Room and other Safety First propaganda. The Society is, in fact, the ' jam ' which goes with the ' pill ' ! A very fine show of models has been promised and most of the steam-engines will be running actually under steam. The president is fitting up a vertical boiler for this purpose. Neighbouring clubs are assisting by loaning exhibits, and a few trade stands will also be there. Incidentally, several models which are the subject of articles in THE MODEL ENGINEER will be on show. A member, Mr. T. Spike, is showing his hacksaw machine which was described a few weeks ago and Mr. Pritchard is exhibiting his portable workshop which was the subject of an article late last year.

Percival Marshall

MEN LIKE OURSELVES

by W. L. Randell

1.—SIR CHARLES PARSONS

FEW men possessed expert knowledge in so many fields as Charles Parsons. He was at home in astronomy—this was to be expected, since his father, the Earl of Rosse, built the famous telescope at Parsonstown, Ireland, which was the largest reflector in the world until the close of the nineteenth century. But mechanics, glass-making, acoustics, electric lamp making, the generation of electricity, and many other subjects were equally familiar to him, though he is known best for his genius in developing the principle of the steam turbine and bringing it to such practical success that he revolutionised whole branches of engineering; more particularly those of ship propulsion and electricity supply.

Scientists and inventors, friends of the family, helped to give him a happy boyhood at Birr Castle—"a home whose inspiration was science and whose expression was practical performance." A brother who was for many years Rector of Sandhurst records that Charles was a great model maker from the age of ten, and perfectly happy if only plenty of sealing-wax, cardboard and hatpins could be found; he even made cardboard clocks. Later on these primitive items were discarded for better mechanical toys, but they also were home-made.

Private tuition and two years at Trinity College, Dublin, prepared him for Cambridge, where he worked well and played well. His favourite sport was rowing, and Professor Ewing tells a good story of the 1877 May races, when Parsons was No. 3 in the Lady Margaret boat which bumped Third Trinity. After the bump supper, Parsons, thoroughly happy, "was with difficulty disentangled from a lamp-post to which he clung with a tenacity that afterwards proved to be one of his most valuable characteristics."

Four years as apprentice with Armstrong's, of Newcastle, and two years of research work with Kitson & Co., of Leeds, landed him on the edge of the field where much of his career was to lie. In 1884 he joined the firm of Clarke Chapman & Co., Gateshead, as junior partner. Already he had built a high-speed rotary engine somewhat on the "Gnome" principle, and designed a new type of steam motor; he now turned his attention to the generation of electricity, filing a patent for a high-speed dynamo, and another for a steam-turbine drive. Many of the components he made with his own hands, and expert armature winders said that he could beat them at their own trade.

Evidently this was not a man to be cribbed and cabined. With the financial assistance of a few friends he started in business for himself at

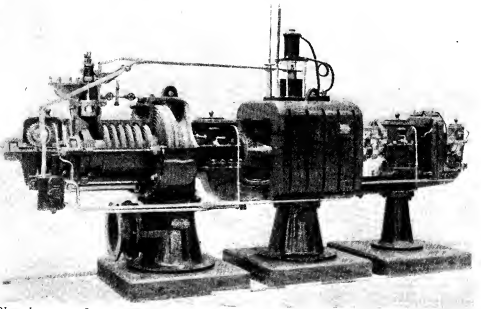


Photo by courtesy] [*C. A. Parsons & Co. Ltd.*

The first condensing turbo-alternator made by Parsons in 1891

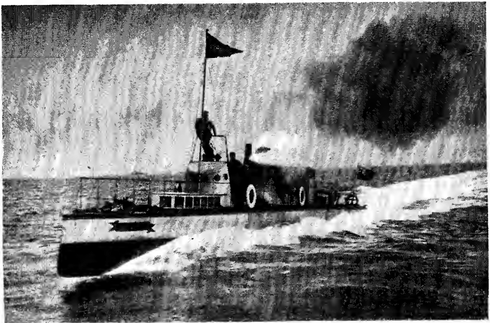


Photo : Science Museum] [*By courtesy of Parsons Marine Steam Turbine Co. Ltd.*
"*Turbinia*" *steaming at* 35 *knots*

Heaton, and the story of his steam turbines begins with their successful use for ship lighting. Propulsion came later; some of our older readers will recall the sensation caused by the little 100-ft. *Turbinia*, built in 1894. Ewing records having seen Parsons carrying sacks of coal into the tiny stokehold so that there should be no delay in beginning an important trial run; and A. A. Campbell Swinton, F.R.S., who was on board, had an amusing note on one of these same trials. A cinema operator on deck was observed to be terror-struck. "This was attributed to his fear at the great speed at which we were travelling, until it was seen that his trousers had become caught in some gear wheels of a counting apparatus fixed on the deck cabin where he was sitting, and were being slowly and inexorably removed."

Those were great days. Electricity was "in the air." People talked about "the new electric light"; Press visits were even organised to big installations; mayors made speeches about it, corporations swelled with pride when piers and promenades displayed the unaccustomed illumination. The reciprocating steam engine, brilliantly improved by Willans and others, held the field as a source of power until the first challenge came with an initial equipment at the Forth Banks station of the Newcastle and District Electric Lighting Company of two 75 kW Parsons sets, running at 4,800 r.p.m. and supplying single-phase current at 1,000 V and 80 cycles. This was in 1890; in 1891 when a scheme was under consideration for a generating station at Cambridge, Ewing was asked to report on the idea of turbine drive. "Parsons gave me every facility to make exhaustive tests," he wrote: "they convinced me that the turbine was the engine of the future, and, like Balaam, I came back blessing where I had been expected to condemn. It was no small privilege to come in contact with the working of so exceptional a mind." The friendship thus begun continued without a break or a cloud.

In his book, "Early Days of the Power Station," R. H. Parsons has some interesting notes on the character of this great engineer. "His enterprise was never restrained by considerations of what had been done, but only by what could safely be accomplished with the materials of the day." He was trained in mathematics, but "his intuition served as an infallible guide in design, and elementary arithmetic sufficed for such calculations as he ever made." He was essentially practical, a man who loved working with his hands. An instance of his skill and energy is given by Lord Rayleigh. In the early days of motoring Parsons had a small car, and once on the Northumberland moors the shaft was so badly bent by bumping over rough tracks that it came to a definite stop. He took out the shaft, lighted a fire to serve as a forge, and with stones for hammer and anvil straightened the shaft well enough to resume the journey. "That was motoring as he understood and enjoyed it."

Every scientific by-way tempted his restless mind. He studied the baffling problem of cavitation in rapidly revolving screw-propellers, and served on the Admiralty committee appointed in 1915 to report on blade-erosion. He designed special methods of gear-cutting for the reduction gears needed between turbine shaft and propeller

shaft. He experimented on re-heating of steam with a view to increased economy and efficiency. He constructed an exceedingly loud speaker, the "auxetophone," christened affectionately and sarcastically by the family the "bellowphone"; "strange and weird were the noises through the nights when he was busy building it," said Lady Parsons. He made a little flying machine, with a spirit boiler, which actually flew. Both as engineer and physicist, the possibility of producing artificial diamonds fascinated him, and he spent much time and money in his later years on the endeavour. "He showed Ewing," says A. W. Ewing, "rather wistfully, it seemed, a collection of natural diamonds, each stone protruding from its matrix of blue clay. Here was Nature's work. What was her method?" This incident happened just before he left England on a trip to the West Indies in January, 1931—the voyage that was to see the close of his life—when Ewing had been lunching with him at his London home.

In that home, in Upper Brook Street, the inaugural meeting of the Electrical Association for Women was held on November 12th, 1924, Lady Parsons presiding informally. The present writer remembers the occasion very clearly; among the group moved Sir Charles, unobtrusively dispensing cups of tea and cigarettes with the friendliest welcome and quiet, smiling comment. Sir Alfred Yarrow was there, and many well-known figures in the electrical world. Lady Parsons herself had a good knowledge of engineering; she was a member of the North-East Coast Institution of Engineers and Shipbuilders, and, intensely interested in her husband's work, in the early years of their married life she used to accompany him on his exciting speed trials.

Charles Parsons was elected a Fellow of the Royal Society in 1898, and received the honour of C.B. in 1904, K.C.B. in 1911, and the most valued Order of Merit in 1927. The Institution of Electrical Engineers awarded him their Kelvin and Faraday Medals; and he was president of the British Association in 1919. He died at sea on February 11th, 1931.

He loved to attempt tasks that people called impossible; he never spared himself. "That undismayed engineer," as one of his friends put it, with the restless mind, had no conceit when he succeeded. "To the last," said Ewing, "there was an endearing quality in his self-effacement, and in the modesty with which he wore his world-wide fame, which gave him a peculiar charm once the veil of shyness was drawn aside." His genius opened up a new era in propulsion and the application of power. Many are left who knew him, and all who knew him learnt something from him of how to live as a man should.

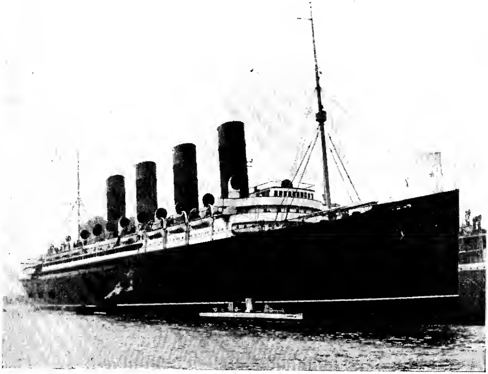


Photo: Science Museum] *[By courtesy of Parsons Marine Steam Turbine Co. Ltd.*

The Experiment and the Result—"Turbinia" and "Mauretania"

COAL-WEIGHING TENDERS

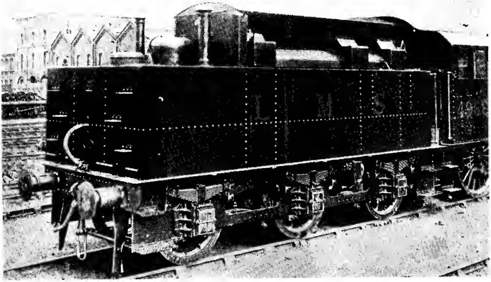
IN SERVICE WITH

THE L.M.S. RAILWAY COMPANY

THE L.M.S. Railway has always paid particular attention to locomotive coal consumption, and two dynamometer cars have been employed in carrying out periodical tests.

In these trials a known weight of coal is placed in the tender, sufficient for the test run to be made, and at the conclusion the coal remaining is removed and weighed. The coal used, with suitable allowances for lighting up and standing time, is related to units of work done by the engine on the train, as recorded by the dynamometer car, to give lbs. of coal per drawbar horsepower hour. These full-scale trials are usually undertaken on only a small number of engines in a class either to compare coal consumption with engines in other classes, or to measure the effect of alterations or special fittings on engines of the same class. The use of the horsepower hour basis for coal measurement minimises the effect of day to day variations in weather and vehicle resistance, and gives data which is primarily directed towards changes in locomotive design.

Owing to increased difficulties of coal supply, both of quantity and quality, the checking of coal consumption is more and more important. With a view to a closer study of the methods of firing, the effect on consumption of traffic delays and other features of present-day operation, together with a closer watch on the effect of the varying qualities of coal, two special coal-weighing tenders have just been completed to the design of Mr. H. G. Ivatt, Chief Mechanical Engineer, L.M.S. Railway, in conjunction with Transport & General Engineering Co. (Leeds) Ltd., the latter firm being responsible for the manufacture of the actual weighing mechanism.

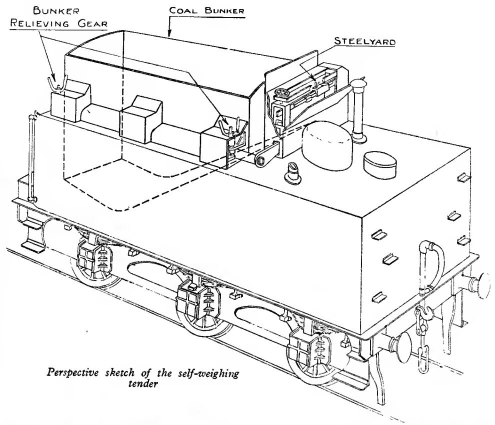


Self-weighing tender—rear perspective view

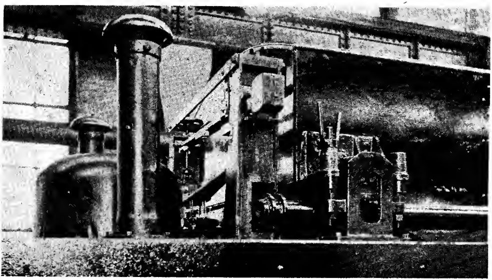
The underframes, wheels and axleboxes are those of the standard 4,000 gallon tender in use on the larger locomotives, but new tanks and coal bunkers have been fitted, which will hold 3,750 gallons of water and $7\frac{3}{4}$ tons of coal as against the 4,000 gallons and 9 tons of the standard arrangement. The tenders can, of course, be coupled to any standard engine.

The coal-weighing device, which is not intended for use while the engine is in motion is arranged as follows :—

A separate coal bunker has been provided which has vertical sides but a self-trimming back and normally rests on six cone seatings on brackets on the tank top and in this position it can be locked, to prevent relative movement



Perspective sketch of the self-weighing tender



The weighing mechanism

and consequential damage to the knife edges of the weighing mechanism. When it is desired to weigh the coal, the locks are released, the load is then transmitted through two shafts running longitudinally along the tender tank top to two main levers situated at the rear of the coal space, and then via another lever to a steelyard. The latter is calibrated to read directly in tons and quarter cwts. by the usual sliding weights, and is provided with devices to lock it in the weighing position or otherwise, to safeguard the knife edges.

In operation, having ascertained that the bunker is in the correct position and all locks engaged, the tender is coaled in the normal manner. The cover is then removed from the steelyard and the steelyard locking devices and those on the bunker itself are released so that the load is being transmitted through the lever system to the steelyard, where the load is measured by adjustment of the large and small weights on the arm. The locking devices are then returned to their normal positions, and the cover replaced when the tender is ready for the road.

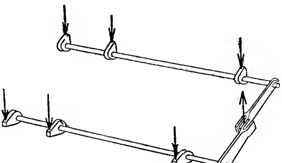
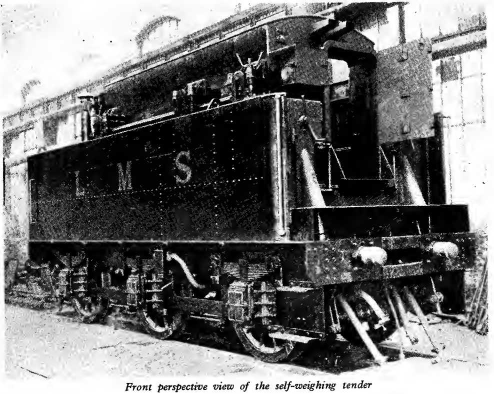


Diagram of levers

The attached perspective drawing and photographs illustrate the operation and appearance of the apparatus.

Locomotive inspectors ride with the engines of these tenders whenever they are working a train, and coal weighing is undertaken so that the day's consumption can be broken down as desired into that used for lighting up, shed duties, shunting, and also while working the train, and during any traffic delays which may occur. The variation in consumption due to the best methods of firing and engine working can be demonstrated to the crew, and methods be developed for getting the best results from the lower grades of coal being used.



Front perspective view of the self-weighing tender

PETROL ENGINE TOPICS

* A 15-c.c. FOUR-CYLINDER ENGINE

By Edgar T. Westbury

A GOOD deal of thought has been devoted to the design of the carburettor, in order to produce a device which is compact, and simple both in construction and adjustment, while at the same time efficient and capable of a wide range of speed control. Simplicity is an essential virtue in a carburettor for so small an engine, because complication not only increases the difficulty of construction, but may also defeat its own purpose by introducing more things to go wrong or out of adjustment. At the same time, however, it is none the less essential to the success of the engine as a whole that the carburettor should do its job without fuss or continual nursing. The space available for the fitting of the carburettor is by no means unlimited, and it is desirable, even if only for appearance sake, to keep it more or less within some semblance of scale proportion.

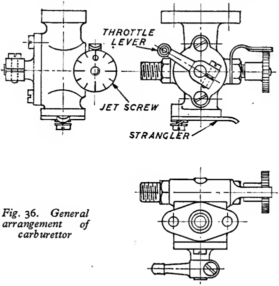


Fig. 36. *General arrangement of carburettor*

It has not been considered necessary to use float-feed on this carburettor, as small floats, although quite successful if properly made and adjusted, are frequently a source of trouble, and are worse than useless unless they can be relied upon not to flood or stick. Suction feed will give good results if the fuel tank is made fairly shallow and not too far below the jet level; the low position of the carburettor, when used as normally intended, on the underside of the manifold, favours a convenient arrangement and location of the tank.

The carburettor has a barrel throttle, which is designed to produce mechanical compensation of the mixture, as described in recent articles on carburation. Several successful carburettors of my design, including the " Kiwi " employed on the 15 c.c. engine of the same name, work on this principle, which is quite effective for speed control, though it gives no automatic compensation for varying load. It may be remarked, in passing, that a " Kiwi " carburettor is used on the 50 c.c. four-cylinder engine made by Mr. W. Savage (which has been mentioned and illustrated in THE MODEL ENGINEER in connection with magneto experiments) and has always given satisfactory and consistent results.

The jet is arranged horizontally at the back of the carburettor, this position being convenient for accessibility of adjustment, and also for connecting up the feed pipe. It is of more or less orthodox design, controlled by the usual screwed head and taper needle, but is not situated in the main air passage—a small air passage, little more than an " air bleed," being provided to act as a primary choke, and this communicates with a hole in the centre of the throttle barrel. The main air passage is tapered from the discharge end, and flared at the intake, to form a venturi tube, the centre part of which is formed in the throttle barrel, which registers with the main passage when fully open. (See Fig. 36.)

The operation of the carburettor should be quite clear to readers who have followed my articles on this subject, but may be briefly explained as follows: At full throttle, air flows rapidly through the bore of the main passage, which has a high coefficient of discharge, yet is so proportioned as to produce a suction effect sufficiently strong to induce extra air to flow through the primary choke and also draw fuel from the jet. Thus the primary choke discharges a rich air-fuel mixture into the main air stream, in the same manner as an " emulsion jet " used in many full-sized carburettors; the richness being adjusted by the screw-needle, so that, when diluted by the main air stream, it is of the correct strength for combustion.

When the flow of air is restricted by the partial closing of the throttle, changes in the air pressure and velocity take place which affect the discharge of fuel from the jet. The relative areas of the passage at the intake and discharge edges of the throttle barrel here exert a controlling influence, and must be adjusted to obtain the best results at all positions of throttle opening.

If the throttle were designed to cut off on the

**Continued from page* 722, " *M.E.,*" *June* 12, 1947.

discharge side only, while allowing a free flow at the intake side, it is clear that the suction at the aperture of the primary choke would rapidly diminish with the closing of the throttle, so that the discharge from the jet would fall off so much as to produce a weakening mixture under these conditions. But if closure takes place at the intake end only, the opposite effect is produced; suction at the primary choke is increased, and the mixture becomes richer as the throttle is closed.

Somewhere between these extremes, a state of affairs can be reached in which just sufficient suction can be diverted to the primary choke to maintain something approaching the correct mixture at all positions of throttle opening. In practice, it is found necessary to close the intake somewhat more rapidly than the discharge, which can be done quite conveniently by tapering the main air passage. But it must be emphasised that some "cutting and trying" is nearly always necessary to obtain the optimum result on any particular engine

It is intended that the jet adjustment of this carburettor should remain constant when once set, though some slight readjustment may occasionally be found necessary to allow for climatic conditions or variation of fuel quality. But continual knob-twiddling is neither necessary nor desirable. To facilitate starting, a strangler is provided at the main intake, but it is again emphasised that this, also, is not intended to be used as a running control.

Carburettor Body

This is made from a casting, machined to the dimensions shown in Fig. 37. It is advisable first to machine the throttle-barrel housing, holding the casting across the four-jaw chuck for this operation. Do not drill the hole through the jet housing at this setting, as it may throw the drill out of truth when subsequently drilling the hole for the jet-tube; but it may be started with the pilot end of the centre drill, so that its position may be correctly located afterwards.

Bore the throttle housing parallel, and to a good finish; one does not aim at air-tightness in a throttle-valve, but the better it is finished, the smoother it will work. Before boring the main air passage, the throttle barrel should be turned and fitted, the cover also being machined, but with the register spigot left proud, so that when screwed down it will bear on the barrel and hold it tight for the boring operation. Assuming these parts are made, the passage can now be bored, holding the casting from the intake end and first drilling a centre hole right through 5/32 in. diameter and using a taper reamer or D-bit to open up the discharge end. The exact taper is not specified, nor can it be predetermined, to ensure correct operation of the carburettor beforehand; but an included angle of about 10 deg., as used for fitting shaft tapers, will be somewhere near correct, and in view of the general utility of a D-bit of this angle of taper, it will be worth while to make one. For preference, a long cutting angle, to cover sizes from $\frac{1}{8}$ in. to $\frac{3}{8}$ in. diameter, will be found most useful.

Do not, on any account, open up the bore to finished size right away, in view of the fact that adjustment of the bore will almost certainly be necessary, and as everyone knows, it is much easier to remove metal than to put it back afterwards! It will be sufficient to enter the reamer just far enough to taper out about half the length of the throttle barrel at first. The intake end of the passage may be flared out with a hand-tool, the casting being mounted on a taper plug held in the chuck.

The jet housing may be drilled in a drilling machine, but accuracy in centring the hole is facilitated if the casting is mounted, throttle housing face down, on a small angle-plate attached to the lathe faceplate. Drill the hole 9/64 in. diameter right through and face both ends truly. The No. 60 cross hole may now be drilled from the outside of the casting, and the 3/32 in. hole from the inside of the housing drilled to line up with it.

Jet Tube

This is made from hexagonal brass rod, approximately 7/32 in. across flats, and the plain portion should be turned to a sliding fit in the bore of the jet housing, the end being screwed 4-B.A. for a length of $\frac{3}{8}$ in. Take care to centre and drill the hole truly, running the work at the highest possible speed and using a sharp $\frac{1}{16}$ in. or No. 52 drill. If desired, the No. 70 hole may also be drilled at this setting, but there are some advantages in drilling it from the other end.

To ensure true running of the work when reversed, it should be chucked by drilling a true hole in a piece of rod held in the lathe chuck, and tapping it 4 B.A., with a 9/64-in. counterbore to a depth of $\frac{9}{16}$ in., so that it will screw in up to the shoulder. The screwed and internally-coned end of the jet tube, to provide for a union joint, is optional, but is considered preferable to the more common nipple end for rubber-tube connection. A flexible pipe-joint has its advantages, both in convenience and also as a means of preventing pipe breakage by vibration, but one wonders whether its adoption is not, in many cases, the line of least resistance on the part of the constructor.

The internal cone may be formed by means of the centre-drill, and a $\frac{1}{16}$ in. hole is then drilled to a depth of $\frac{7}{16}$ in. from the end, after which a No. 70 drill is used to form the jet orifice. I find it best to apply these tiny drills by hand, holding them in a small pin-chuck, with the lathe running at top speed.

After fitting the jet tube in position and securing it with a 4-B.A. nut at the end, the cross hole may be drilled to line up with the cross holes in the jet housing. It is, of course, essential that the jet tube should always be assembled with these cross holes in line, and it may be found advisable to provide some means of ensuring this, such as by marking the appropriate flats of the hexagon, or fitting a tiny snug key.

Jet Adjusting Screw

This is, strictly speaking, not a screw at all, being an internally-threaded knurled head, into which the tapered jet-needle is sweated after assembly. An ordinary dress-pin serves quite well for a jet-needle, though a stainless-steel or German silver needle is stronger and more durable; in either case, a fairly fine taper is desirable to facili-

tate exact adjustment. The knurled head should be screwed on to the end of the jet tube almost as far as it will go, after which the needle is pushed right home in the jet and sweated in position. Clean off the face of the knurled head, and make

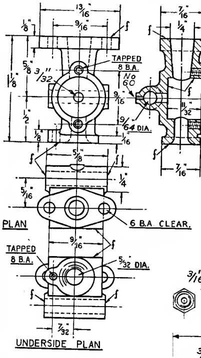


Fig. 37. Carburettor body

one or more radial marks on it to indicate its position.

The check spring may be filed to shape from any suitable material, such as phosphor-bronze strip or a piece of old clock-spring. The extended end should be formed into a concave channel by hammering it into a vee-block with the pane of the hammer, so that it will bear firmly on the knurling of the head when bent to the shape shown. It is secured under the jet-tube nut as shown in the general arrangement (Fig. 36).

Throttle Barrel and Cover

These are shown in the detail group (Fig. 38), and are quite a straightforward turning job, the barrel and shank being turned from brass rod at one setting. It should turn smoothly in the throttle housing, and as already described, is fitted in place for boring the cross hole. This should be done before drilling the 3/32-in. hole at the back to communicate with the primary choke.

As already stated, the cover is at first made with the register spigot long enough to clamp the barrel in place when the screws are tightened. The surplus length is afterwards faced off to allow the barrel to turn freely, but with little or no end-play, and if desired, the outer part of the face may be relieved slightly to reduce friction. Alternatively, it may be preferred to introduce friction, if control direct from the throttle lever is desired, and in this case, the centre hole may be counterbored to take a double-turn spring washer.

Throttle Lever

The form of this may be varied to suit the preference or convenience of the constructor. If direct control is used, the lever may be longer than that shown, and some form of quadrant plate attached to the throttle cover will be helpful. The form shown is suitable for use where control rods are fitted to enable the engine to be controlled from some remote point, and a pivot-pin or ball-socket joint may be fitted to the small end of the lever for this purpose.

The bore at the large end of the lever should be a fairly tight fit on the shank of the barrel before splitting, so that the minimum distortion takes place in clamping up. Fit the clamping

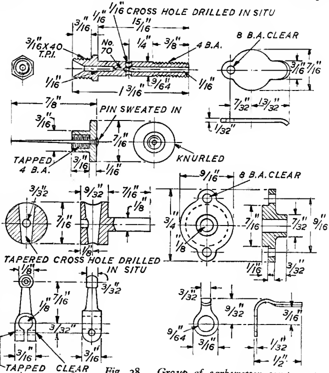


Fig. 38. Group of carburettor components

screw as close as possible to the shank, even to the extent of having to groove the latter to get it in, as this ensures maximum security of grip.

It will be noted that no means of limiting the throttle movement, or fitting a slow-running stop, are provided. The main reason for this is that

it is desired to allow for fitting the lever in any position, for either vertical, horizontal or oblique motion of the control rod. In view of the small dimensions of the parts, a slow-running stop would be a rather finicky fitting, not only to make, but also to handle. If desired, pins may be fitted to the barrel cover in appropriate positions to limit the opening and closing movement of the lever, and one of these might be made eccentric to allow of slow running adjustment. Another method of providing an adjustable stop is to fit a screw horizontally through the side of the passage so that it abuts against the top edge of the barrel aperture, as in the " Kiwi " carburettor.

It should be noted that in the form shown, the throttle will close by turning in either direction; but should the axis of the barrel not coincide with that of the air passage, or any other deviation from symmetry be introduced, the compensation characteristics will not be the same for both directions, so it is best to legislate for one-way traffic only. A convenient method of operating the throttle, when a full control system is not fitted, is to fit a screwed vertical rod, passing through a hole in a bracket attached to the top of the manifold, and having a knurled adjusting nut and return spring. The slow-running stop could then consist of a couple of lock-nuts, adjusted to the required position on the rod and locked.

The strangler is simply a flat plate of brass or duralumin, filed to the shape shown, and attached by means of an 8-B.A. steel screw with a spring-washer to act as a friction pivot-joint. Tap the screw hole with a taper-tap, in such a way that the screw will fit tightly on the thread without compressing the washer hard up against the plate. A slight bend of the lug on the plate will assist operating it.

When the carburettor is first fitted, it should be adjusted to give the best results with the throttle wide open, and the engine running under load. Next try closing the throttle and note carefully whether the mixture gets weaker or richer. If the former is the case, the area of the discharge end of the throttle barrel should be increased relative to the intake end, by reamering out the bore of the passage with the barrel in position. If, however, the mixture tends to become richer as the throttle is closed, the intake end of the barrel should be opened out, or a vee-notch filed on the closing side; the latter is usually the best method of getting a fine adjustment of mixture at the lower end of the speed range. Some enrichment of the mixture is absolutely necessary to obtain good idling at low speed, but the engine should never " hunt " or " eight-stroke."

In order to be certain which side the error is on, if one is not certain, the jet-screw may be readjusted, for experimental purposes only, at various throttle positions, when it will easily be found whether it requires to be opened or closed to produce the best running results. It should never be necessary to alter the jet to suit varying throttle positions, once the proper proportions of the air passages have been arrived at. If the carburettor fails to give proper speed control on the throttle lever only, do not blame the design—blame your own lack of skill or patience in arriving at its initial adjustment.

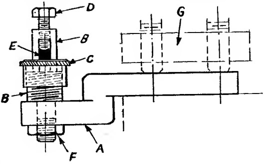
Sometimes it is found difficult to ensure easy starting with fixed jet settings, even when a strangler is used, due to the reluctance of the cold fuel to flow through the jet, especially if the latter is fairly high above the tank level. In such cases, it is permissible to open the jet temporarily for the first few seconds of run, while warming the engine up. An alternative method is the somewhat undignified but highly effective dodge of giving the fuel an initial lift by blowing down the air vent of the tank filler-cap.

(To be continued.)

Small Tool-Holders

THE article by Mr. Hall Bramley on a double tool holder, in the February 6th, issue was very interesting, but it does not appear to be generally known, that a small lantern-type tool-post fixed on the end of a cranked bar, will be found a most valuable appliance, enabling instrument turning to be done on a big lathe, with complete facility of adjustment of small cutters, and no messing about with packing-pieces.

I give a sketch and description and those who have occasional delicate jobs to do on a lathe will find this tool of assistance.



The principle may, of course, be extended, by making a rising barrel to sit on the slide-rest itself, with a slotted tool-post, this gives perfect height adjustment, and a curved pad or wedge will tilt to give an adjustment for rake as well.

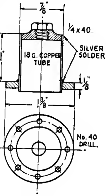
Details of the tool-holder are: A— Cranked bar forming base of the tool-holder; BB—The screwed barrel and tool-post in one piece; C—The adjustable collar; D—The clamping bolt; E—The tool for turning or boring, etc.; F—Nut holding B to A, by loosening this the tool may be made to stand at any angle to the cranked bar, A; G—The clamp on the top slide of the lathe.

—H. H. McHALL.

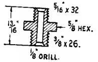
"L.B.S.C."

TESTING "JULIET'S" BOILER

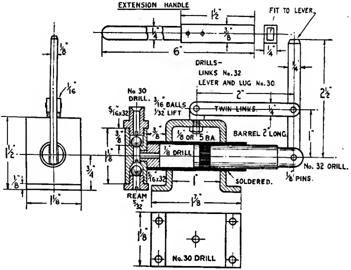
IT is only just recently that I described how to test "Hielan' Lassie's" boiler, so there is hardly any need to set out the whole doings in full detail again; however, for beginners' benefit, here is a brief summary, with details and illustrations of the inner dome, and emergency hand pump, which will be used for the job. To reassure any nervous souls who might be terrified at the idea of putting a lot of pressure in the boiler, and getting a big bang if their workmanship doesn't stand the strain, there is no danger what-



Inner dome



Adapter for testing boiler



Emergency hand pump

ever. If anything gave way, the pressure would immediately be released without the least chance of explosion; there might be a tiny crack, hardly audible, and the worst damage the operator could sustain, would be a few drops of water either on his clothes or personal anatomy. Nothing more—though maybe his peace of mind would be upset! But be of good cheer; if you have faithfully followed the "directions on the label," there won't be as much as a solitary tear-drop escaping where it shouldn't. One big advantage of building a little steam locomotive is that you don't have to be an expert of many years' standing, to make a success of it. Well, to business.

Inner Dome

The inner dome may be either cast or built up. If a casting is used, it only needs chucking by the body, and the underside of the flange faced up with a knife-tool, to make contact with the dome bush. A slight projection is turned below the flange, to fit inside the bush, like the register of a cylinder cover. The casting is then reversed in the chuck, and the top faced off, centred, drilled No. 3 or 7/32-in. and tapped $\frac{1}{4}$ in. by 40 for an oiling plug for the regulator.

To make a built-up dome, cut a piece of $\frac{7}{8}$-in. copper tube—18-gauge for preference, though 16 or 20 can be used—to a length of about $1\frac{3}{8}$ in. Chuck in three-jaw and face off each end, so that the finished length is $1\frac{1}{4}$ in. On a piece of $\frac{1}{8}$-in. sheet brass, mark out a circle $1\frac{3}{8}$ in. diameter, and another $\frac{7}{8}$ in. diameter inside it. Saw out roughly to shape; then chuck in three-jaw, centre, drill a pilot-hole about $\frac{3}{16}$ in., and if you have not got a $\frac{7}{8}$-in. drill, poke the biggest one you have, through the plate, and then bore out with an ordinary boring tool, until the hole is a drive-fit for the piece of $\frac{7}{8}$-in. tube. If you have a piece of brass rod $\frac{7}{8}$ in. or over, chuck in three-jaw, and turn the end of it to the outline shown in the illustration, slightly chamfering the edge. Centre, drill 7/32 in. for about $\frac{5}{16}$-in. depth, tap $\frac{1}{4}$ in. by 40, and countersink the hole slightly. Turn down about $\frac{3}{16}$-in. length to a drive-fit in the $\frac{7}{8}$-in. tube, and part off about $\frac{3}{16}$ in. from the end.

If you haven't a piece of rod big enough, cut out a disc of $\frac{1}{16}$-in. sheet copper, and drive it tightly in the end of the tube; chuck in three-jaw, centre the disc, drill it $\frac{5}{16}$ in., and make a bush to fit it, like the safety-valve bush, only use $\frac{3}{8}$-in. rod, shouldered down to a tight fit in the

$\frac{5}{16}$-in. hole. Drill 7/32 in., tap $\frac{1}{4}$ in. by 40, countersink slightly, and part-off about 3/32 in. behind the shoulder. Put the big flange on the bottom end, leaving about $\frac{1}{16}$ in. of the $\frac{5}{8}$-in. tube projecting; then silver-solder both ends at one heat. After pickling and cleaning up, chuck the body of the fitting in the three-jaw, same as a casting, and take a skim off the contact side of the flange, with a knife-tool, to ensure proper contact with the bush in the boiler; also turn the flange to $1\frac{3}{8}$ in. diameter.

Whether cast or built-up construction is used, drill eight No. 40 holes in the flange, and scrape or file off any burring. Make a little plug for the hole in the top, using $\frac{5}{16}$-in. hexagon rod. Put the dome in position on the bush, and run the 40-drill through one of the holes, making a countersink on the bush. Remove dome, drill out the countersink with No. 48 drill, and tap 3/32 in. or 7-B.A. Replace dome, and secure temporarily with a single screw; then "ditto repeato" the process on the other seven at one fell swoop, just like fitting a cylinder cover. Finally, assemble with a 1/64-in. Hallite or similar joint-gasket between dome and flange; and use brass screws, either round or cheese-head, for fixing permanently.

Testing Adapters

Two of these are needed; only a few minutes' work apiece. Chuck a piece of $\frac{5}{8}$-in. hexagon brass rod in three-jaw; face the end, and centre deeply. Turn down $\frac{5}{16}$ in. of outside to $\frac{3}{8}$ in. diameter, and screw $\frac{3}{8}$ in. by 26, to match the safety-valve bush. Part off at $\frac{13}{16}$ in. from end; reverse in chuck, centre deeply and drill right through with $\frac{1}{8}$-in. or No. 30 drill. Turn down $\frac{1}{4}$ in. of the outside to $\frac{5}{16}$ in. diameter, screw $\frac{5}{16}$ in. by 32, and you're through. Make another one, but instead of screwing the bottom end $\frac{3}{8}$ in. by 26, screw it $\frac{3}{8}$ in. by 40, to match the hole in the smokebox tubeplate.

Emergency Hand Pump

As the emergency hand pump does fine for the boiler test, it can be made right away, and put aside after test, until the side tanks are fitted. The construction is the same as "Lassie's," and very similar to the eccentric-driven pump only just recently illustrated; so a short description should suffice. No castings are needed. The stand is made from a piece of brass or copper $\frac{1}{8}$ in. in thickness, $1\frac{1}{8}$ in. wide and approximately $4\frac{3}{4}$ in. long, bent to the shape shown. I use a piece of 1-in. square iron bar for doing this job, first bending the arch over the bar, then putting same in vice with the bar between the "legs," the latter pointing skyward, and then knocking them outwards, flat on the tops of the vice-jaws. The whole process takes only a few minutes. Drill a No. 30 hole in each corner, one in the top of the arch, and one in the middle of each side. Open out the latter with a 35/64-in. drill (or the nearest smaller available) and ream $\frac{9}{16}$ in.; the hole should be a tight fit on the $\frac{9}{16}$-in. barrel tube.

The valve-box is a $1\frac{1}{8}$-in. length of $\frac{7}{16}$-in. brass rod squared off at both ends in the lathe, drilled right through with No. 24 drill. The valve-chambers are formed exactly as described for the eccentric-driven pump, using 9/32-in. drill and D-bit, and tapping $\frac{5}{16}$ in. by 32. Ream the centre part 5/32 in., and use 3/16-in. balls, allowing 1/32 in. lift. The upper cap is the same as the eccentric-driven pump, except that it is screwed $\frac{5}{16}$ in. by 32 instead of $\frac{3}{8}$ in.; and the lower cap has no threaded part below the hexagon, which is turned off flush, and cross-nicked with file or hacksaw. A 7/32-in. hole is drilled in the side of the valve-box between the ball chambers, and tapped $\frac{1}{4}$ in. by 40.

The barrel is a 2-in. length of $\frac{9}{16}$-in. brass treblet tube, squared off at both ends. A brass plug is turned to fit tightly in one end, and the end of this is shouldered down to $\frac{1}{4}$ in. diameter, and screwed to fit the hole in valve-box. The tube is then pushed through the holes in stand, with valve-box vertical, and D-bitted end uppermost; sweat over the joint between barrel and valve-box, and where the tube passes through the stand.

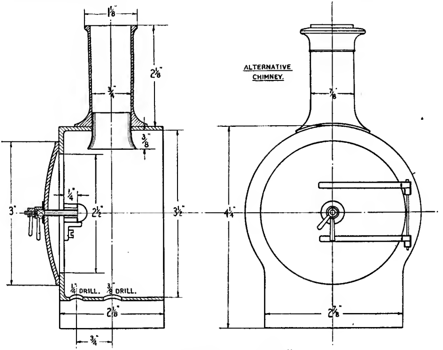
The ram is a $2\frac{1}{4}$-in. length of $\frac{1}{2}$-in. bronze, gunmetal or rustless-steel rod, which should be an exact sliding-fit for the treblet-tube barrel, and should not need turning; but if the tube is over $\frac{1}{2}$ in. in the bore, the ram must be turned to fit, from a suitable piece of rod metal. One end is reduced to $\frac{3}{8}$ in. diameter for $\frac{1}{2}$-in. length, and slotted to accommodate the operating lever, also cross-drilled with No. 32 drill for a $\frac{1}{8}$-in. pin. The other end has a groove $\frac{1}{8}$-in. wide and same depth, turned in it $\frac{1}{8}$ in. from the end. This is packed, preferably with a bit of unravelled hydraulic pump packing; but if this is not available, a few strands of graphited yarn will do, same as used for pistons and glands. The lever is a $2\frac{1}{2}$-in. length of $\frac{1}{8}$-in. by $\frac{1}{4}$-in. brass or nickel-bronze rod, with two No. 30 holes in it; one at bottom, and the other 1 in. above it. Two links, of $\frac{1}{4}$-in. by $\frac{1}{16}$-in. brass or nickel-bronze rod, with No. 32 holes drilled at 2-in. centres, are pinned to the upper hole. The other ends are pinned to a lug made from same kind of material as lever, turned down to $\frac{1}{8}$ in. diameter at bottom, screwed $\frac{1}{8}$ in. or 5-B.A., put through the hole in the top of the stand, and secured by a brass nut.

When in position on the engine, the pump will be operated by an extension handle worked through the filling hole in one of the side tanks. This handle will be needed when testing the boiler, to get sufficient leverage to pump up the required pressure. It is merely a 5-in. length of the same kind of rod as used for the pump lever, with a socket on one end, to fit over the lever. This socket may be either a $1\frac{1}{2}$-in. length of $\frac{3}{8}$-in. by $\frac{1}{4}$-in. rectangular tube (commercial article sold by metal merchants) or a piece of 16-gauge sheet-brass bent around the pump handle to correct outline, and the joint silver-soldered, also letting the silver-solder fix the socket to the handle instead of using the rivets shown. The above condensed description of the emergency pump, plus the illustrations, should enable anybody who has made the eccentric-driven pump, to make the hand-operated one. I nicknamed it my "two-hour" pump, because that was exactly how long it took me to make one at the time I first introduced it to readers of these notes. I can do them a bit quicker now, especially by making three or four at one go. Its capacity per

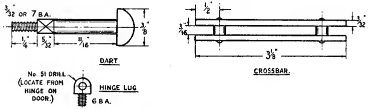
stroke is about four times that of the ridiculous type of commercial pump in which the lever is pivoted to the base, and the undersize ram passes through an outsize in external glands.

Rig-up for Testing

To make the actual test, screw the adapters into the safety-valve bush and thc hole in the plug on top of the dome, and fill the boiler completely with cold water, right up to the plug, which is then replaced tightly. A very few strokes of the pump will send the gauge needle up to 50 lb., at which point the boiler should be examined for leaks and bulges. If all O.K., raise the pressure gradually to 160 lb. with pauses for a "looksee" at about every 30 lb. increase, to



Cast smokebox for "Juliet"



Smokebox door fastenings

smokebox tube-plate. Connect the former to a pressure-gauge reading to 200 lb. or over. *Don't* on any account use the gauge you will be fixing on the boiler to indicate steam pressure in service, or you will "do it in"; these little gauges are not suitable for such strenuous jobs. A full-size steam-gauge, or a hydraulic gauge such as used for indicating oil or water pressure on small hydraulic jacks or presses, is O.K. for the job; I use a full-size locomotive gauge reading to 360 lb. The other adapter is connected to the top of the pump valve-box, both connections being made by bits of copper tube with suitable union-nuts and cones on the ends, and the pump is placed in a pan of water. Take out the screw see if anything untoward is happening. If you arrive at 160 lb. without a "bust-up" as the kiddies say, and the boiler holds it all right, you can take your competent boilersmith's certificate. A slight movement of the crown-sheet, or any other part of the boiler, as the pressure rises, provided it is no more than about 1/32 in., is of no consequence, as it will be due to the copper, softened by the brazing process, merely taking up the best position to resist the stress. Let off the pressure and empty out the water, and the boiler is now ready for smokebox and various other adornments. Should any leak have developed during the test, it should, of course, be remedied before proceeding any further.

Smokebox—Cast Pattern

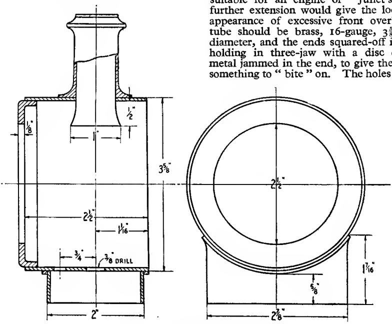
The smokebox I recommend for "Juliet" is the simple one-piece casting as supplied for "Petrolea," as this does away with a separate ring or front-plate, and dispenses with a saddle. However, if a casting is not easily obtainable, an alternative drawing is given, showing a smokebox made from tube, and mounted on a saddle, which may be either a casting, or built up. The cast smokebox is easy to machine. Chuck in four-jaw with the open end outwards, and set it to run truly. Face-off the end with a round-nose tool set crosswise in the rest; then, with an ordinary boring-tool, bore out the inside to a tight push-fit for the boiler barrel, to a depth of about $\frac{3}{8}$ in. Reverse in chuck, and face-off the front. The outside can be smoothed down with a file, and finished with emery-cloth. Drill a $\frac{7}{8}$-in. hole in the top, for the chimney liner; and exactly opposite, at the bottom, a $\frac{3}{8}$-in. hole for the blast-pipe. At $\frac{3}{4}$ in. ahead of the blast-pipe hole, drill a $\frac{1}{4}$-in. hole for the steam-pipe; or if the union is silver-soldered to the pipe, make the hole big enough for the union to pass through. Beginners note, the best way to get the chimney hole right, is to scribe a circle on top of the smokebox; drill a small hole first, say $\frac{3}{16}$-in., then open it out by stages; and if the $\frac{7}{8}$-in. hole isn't going to line up with the circle, you'll be able to correct it with a file, before getting to the full size.

A cast door will be supplied with the cast smokebox. Very little machining will be needed on that; just chuck in three-jaw by the chucking-piece provided, and face-off the contact edge with a round-nose tool set crosswise in the rest. Don't run too fast, or the facing will be covered with chattermarks, and the door won't close airtight. Centre, and drill a No. 30 hole through the whole lot, door and chucking piece; then either reverse the door in the chuck, gripping by the edge in the outside jaws, and face-off the chucking-piece, or else saw it off, and give the "stump" a truing-up skim. The doo is fitted as described below for the built up contraption.

Smokebox Made from Tube

Some folk like to see a smokebox extended to pouter-pigeon dimensions; there's no accounting for some folk's tastes, as the waitress said when the customer put a kipper into a plate of mutton broth! A smokebox made from tube may either be cut to the dimension given for the cast variety, or it may be made a little longer, as in the accompanying illustration, which shows an alternative tube smokebox $2\frac{1}{2}$ in. long. This would be suitable for an engine of "Juliet's" type; a further extension would give the locomotive an appearance of excessive front overhang. The tube should be brass, 16-gauge, $3\frac{5}{8}$ in. outside diameter, and the ends squared-off in the lathe, holding in three-jaw with a disc of wood or metal jammed in the end, to give the chuck-jaws something to "bite" on. The holes for chimney and pipes, are drilled $1\frac{1}{16}$ in. from the boiler end. The ring, or smokebox front, is knocked up from a disc of $\frac{1}{8}$-in. brass about 4 in. diameter, over the former used for the smokebox tube-plate. The ragged edge is skimmed off and the flange turned to fit the smokebox, as described for the tube-plate; but the convex side is faced off, with the flange held by the outside, in the three-jaw, and a hole $2\frac{1}{2}$ in. diameter cut by aid of a parting-tool.

A cast door may be used with this type of front, or you can make one from a brass disc $\frac{1}{8}$ in. thick and a little over 3 in. diameter. Anneal it, and lay on a block of lead; hit it with the ball-end of the hammer, starting from the middle and going around in a circle, until it looks like a saucer. Then chuck in three-jaw, gripping by the edge, concave side out; face off the edge to form a contact ring with the smokebox front.



Built-up smokebox and saddle

Centre, and drill a No. 30 hole through ; face a piece in the centre, around the hole, about $\frac{3}{4}$ in. diameter. Chuck a piece of brass rod about $\frac{5}{8}$ in. diameter, and turn a pip on the end, to fit the hole. Drive it in, and solder the rod to the facing. The bit of rod then forms a chucking-piece, which is held in the three-jaw, and enables the door to be turned all over the convex side and reduced to correct diameter at the one setting. Inexperienced lathe hands will find it a ticklish job to turn the convex side without umpteen tool marks showing. I usually finish mine with a hand graver ; but a smooth file applied judiciously, and followed with emery-cloth or other abrasive, will do the trick. Always spread a rag, or sheet of paper, over the lathe-bed when using emery-cloth, otherwise the confounded stuff will get into the screws and slides, and play old Harry. Lathes are dear nowadays ! Melt out the chucking piece ; make a couple of hinge-straps from $\frac{1}{8}$-in. by 18-gauge strip (nickel-bronze will do) riveted on with domestic pins. Mention of those always reminds me of an old friend who rang me up one evening at Norbury, many years ago, and wanted to know what the heck " dome-stick " pins were! The loops at the end, for the hinge-pin, are made by bending the strip into a loop with a small pair of round-nose pliers, and silver-soldering the joint. Don't be alarmed if the loop gets filled up solid—just put a No. 51 drill through it!

Door Fixing

Either type of door is attached to either type of smokebox in the same way. Turn up a couple of little lugs from $\frac{1}{8}$-in. by $\frac{1}{4}$-in. flat brass rod chucked truly in four-jaw, as shown in detail sketch, but don't drill them yet. Then make up the cross-bar and dart ; the former is merely two $3\frac{1}{8}$-in. lengths of 3/32-in. by $\frac{1}{4}$-in. black steel strip with $\frac{3}{16}$-in. spacers at $\frac{1}{2}$ in. from each end, riveted together with 3/32-in. iron rivets. The dart is turned from $\frac{3}{8}$-in. round mild-steel held in three-jaw. Turn down 1 3/32-in. length to $\frac{1}{8}$ in. diameter ; further reduce $\frac{1}{4}$ in. to 3/32 in. diameter and screw 7-B.A. or 3/32-in. File a square 5/32-in. long, immediately behind this. Part off to leave a head $\frac{3}{16}$ in. long, and file to shape shown, flattening same to $\frac{1}{8}$ in. to match the spindle. The " key " is a $\frac{3}{16}$-in. slice of $\frac{1}{4}$-in. steel rod, with a 3/32-in. hole drilled in it, and filed square to fit the dart. The locking-handle is a $\frac{3}{16}$-in. slice of $\frac{3}{16}$-in. rod, drilled and tapped to match the screw on the dart. Both have a handle made of 15-gauge spoke-wire, either screwed or silver-soldered into them, as shown in the illustrations.

Hold the crossbar temporarily in position at the back of the smokebox front (says Pat) put on the door, and assemble as shown in section ; adjust door so that hinges are horizontal, and door itself quite central. Then fix two brackets, bent-up from 16-gauge sheet-steel, to support the cross-bar, attaching them to the smokebox ring by screws, and mark the position of the lugs immediately below the hinges. Drill No. 44 holes $\frac{1}{16}$ in. below the ends of the hinges, tap 6-B.A. and screw in the lugs, with door removed. Replace door, run the 51 drill through holes in hinge ends, and carry on through the lugs. For this job, I use a short bit of drill fixed in the end of a piece of $\frac{1}{8}$-in. silver-steel. Make the hinge-pin out of a bit of 16-gauge steel-wire with the top burred over, or a little boss screwed on to it ; trim up the lugs to match the hinges, and Bob's your uncle !

The saddle for supporting a tube smokebox may be either a casting, which will only need cleaning up with a file, or built-up. In the latter case, cut four pieces of 16-gauge metal to the dimensions shown, and assemble in the form of an oblong, either by brazing at the corners, or riveting in small pieces of angle. The flanged saddle-plate on which the barrel of the smokebox rests, is a piece of 16-gauge metal, $2\frac{1}{4}$ in. by $3\frac{1}{2}$ in., with the middle part cut out to let the pipes pass, bent to the same radius as the outside of the smokebox shell, and brazed or silver-soldered to the top of the saddle. It is secured to the smokebox by three or four 3/32-in. screws, roundhead for sake of appearance, run through clearing holes in the edge of the flange, into tapped holes in the smokebox shell.

The chimney can be any type you fancy. I prefer the plain stovepipe, as fitted to " Petrolea," also used by Bill Adams, Bob Urie, and other locomotive engineers of the good old days. Some of the old L.S.W.R. drivers swore by all that was holy (or otherwise !) that Adams's engines never steamed so well when the original chimneys were replaced by Drummond's type. Anyway, that won't apply to " Juliet," so I have shown three alternatives. All are turned up from castings, and attached to the smokebox top by four 3/32-in. or 7-B.A. screws run through the flange, into the smokebox shell. The liner is merely a short bell-mouth extension, to help guide the steam from blower and blast-pipe up the liner ; and it consists of a piece of $\frac{3}{4}$-in. tube, $\frac{3}{4}$ in. long, softened, belled out at the bottom, and pushed up into the chimney from inside the smokebox. If a tight push-fit, nothing further will be needed. The bell-mouth can be formed by driving a bit of tapered steel, or a hardwood handle end, into the softened tube ; or maybe our advertisers could supply a little casting that could be turned and bored to dimensions required.

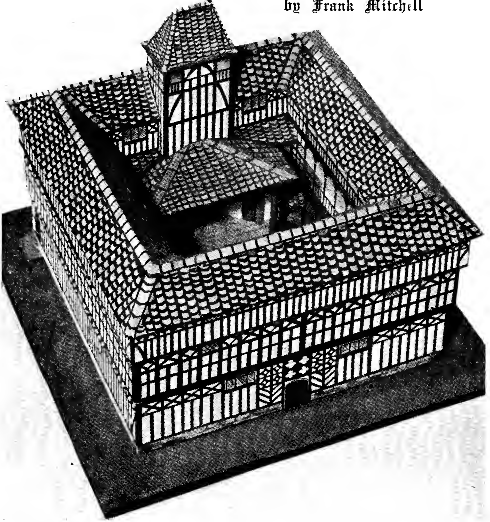
Starting Speedboats by Remote Control

THE starter batteries which will provide the initial impulse to the Goblin II gas-turbine jet-propelled engine of *Bluebird II*, when Sir Malcolm Campbell attempts to raise his own world's water speed record, will *not* be housed on the boat.

A standard Exide battery has been fitted to each of the two starting launches. The battery in the first launch will be used to start the engine on the outward run, whilst its counterpart will take over the job before the return lap. This is necessary because Sir Malcolm may have to switch off his engine at the end of the first lap in order to effect a turn—otherwise the momentum might be too great to allow him to bring his boat around with safety.

A Model "Fortune Theatre"

by Frank Mitchell



The front and stage doors are shown in this view, also stage balconies, tower and flag-staff

THIS model was built to reliable existing builders' plans, to a scale of 1 in. = 8 ft., and represents the Fortune, one of several Shakespearean theatres, built by Philip Henslowe. The Fortune was opened in 1599, two years after Henslowe opened The Rose Theatre.

It will be noticed that the circular plan (like the famous Globe Theatre) had been discarded here. The circular shape was the usual form of buildings built for bear-baiting, cock-fighting, etc., so that the earliest theatres were merely adaptations of such places.

To admit maximum light, the theatre was only partly roofed. The apron stage had a roof to protect the actors so that in the event of wet weather, only the unfortunate people in the "pit" would get wet. (The familiar word "pit," which we still use, shows that the theatre was developed from the bear-baiting, cock-fighting "pits" of former days.) The stage jutted on to the stone-flagged pit, and it will be seen that the first balcony continued around the back of the stage—a peculiar feature of the Elizabethan theatre.

There was only one public entrance to this half-timbered, three storey structure—a state of affairs which would certainly horrify fire-prevention authorities today! For the actors and staff there were two further doors—the stage door—in its traditional place, and a back door giving access to the dressing rooms.

The tower, found on all theatres of this period served several useful purposes. Before the commencement of a performance, a horn was blown from it to summon the audience to their places, and a flag was run up the flag-staff. The tower also contained block and tackle to haul up unwanted pieces of stage furniture, such as thrones, etc., leaving the inner stage clear for the next scene.

The model, correct in architectural detail, is 9 in. × 9 in. in plan, and measures 8 in. to the top of the tower. As can be seen from the photograph, each floor is removable, and the stage can also be taken out and closely examined. Stripwood and Bristol board are the materials used in its construction, all drawing and painting being done on the Bristol board, which was afterwards glued to the $\frac{1}{8}$-in. stripwood. I used Indian ink and poster colour throughout, and then gave the whole job a coat of clear celullose lacquer, which enhanced the finish, made the model impervious to water and damp and strengthened it. The base-board is made up from two square pieces of $\frac{1}{4}$-in. plywood. Since the pit of the theatre was several feet below street level, I cut the centre out of my top piece of ply before nailing and glueing it to the bottom piece.

The job entailed a considerable amount of research to obtain correct details, but I feel that the completed model was well worth the time spent in its conception and construction.

Constructional Details

The purpose of the model is to demonstrate the main features of an Elizabethan theatre. To be really useful as a visual aid to talks on this subject, it was important that whilst the model must be complete and architecturally correct, it must also be so constructed that it could be easily and quickly taken to pieces. Any particular part can then be studied separately so that confusion is avoided.

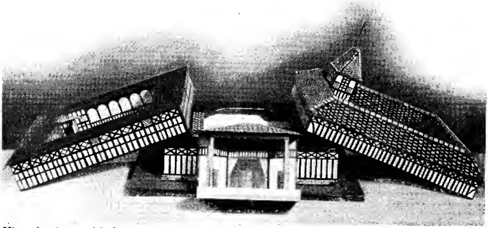
With this in mind, I decided to build the theatre in separate removable storeys or floors, with the stage also a separate and removable unit.

The materials available were strawboard, Bristol board, cartridge paper, plywood, indian ink and poster paint, paste and glue.

I first cut out the floors from strawboard. The walls were then marked out on thin Bristol board. The whole four outside walls of one floor being drawn and painted on one piece. When dry, each piece was turned over and pieces of $\frac{1}{8}$ in. thick stripwood, the size of each individual wall, were glued on to the back of the Bristol board. Thus one continuous piece of Bristol board goes all the way round each outside wall and is stiffened and strengthened by four pieces of stripwood, one for each wall. When dry and set, these walls were then glued to the floor above them (the strawboard) thus making a strong and rigid unit. The inside walls were tackled in the same way.

When the model was built up to the ceiling of the top storey, the roof was constructed as follows :—Triangular pieces of stripwood were glued at frequent intervals on to the top of the strawboard ceiling with small blocks to reinforce them. Fairly thick Bristol board was cut to careful measurements and glued to the triangular supports in four pieces. All joints were covered by a half inch strip of cartridge paper.

The next job was the tower. Made up from stripwood and Bristol board, the tower is attached to the top storey and roof only, with cartridge paper reinforcing strips to make it secure. Previous experience has taught me to avoid unnecessary projections on a model which is moved about so I decided to have the flag-pole



View showing model theatre in its separate parts. Details of stage are visible—inner stage and two side entrances to stage

removable. I happened to have some 3/32 in. bore aluminium tube so I sunk a length of this into the tower roof to act as a socket into which the flag-pole (10-B.A. brass rod) could be placed at will and removed when the model is in transit.

The base is made from two square pieces of plywood nailed and glued together. To obtain the sunken pit of the theatre, the centre of the top layer of plywood was cut out on the fret machine before joining the two layers of plywood. On cartridge paper cut to the same size of this pit, blocks of stone were painted to represent the flag floor and when dry this was glued down into the pit.

All the timber framing was very carefully marked out and then drawn in with a ruling-pen before assembly. The roofs were painted in poster colour.

The most important unit, the stage, was made thus :—A strong base of stripwood was made first, then the roof was cut and assembled and afterwards the back of the stage was made. Each of these parts were then painted and finished. Next, I turned three pillars from dowelling. Two of these support the canopy or roof at the front, the remaining one was sawn down the centre to make two half-pillars to support the canopy at the back. The front two pillars were securely screwed to the stage floor with ¼-in. O brass screws. The back half-pillars were glued to the back wall when the whole stage was finally assembled.

I would like to give a word of warning to those who, like I did in this instance, consult historical books for details and plans for such models as this. I was very pleased when, after a great deal of research in libraries I came across a book containing details and plans and elevations of the Fortune Theatre. Now each drawing appeared on a separate page and all appeared to be in the same scale. Not until I had become quite infuriated by repeated and surprising small errors in my marking out did I decide to check the drawings in the book. I discovered that the plans were just less than ¼-in. less than the elevations—not enough to be noticeable to the eye but more than enough to throw the whole model wrong. Obviously the original drawings were all the same scale but the printers of the book, concerned with arranging their type and illustrations to fit their own requirements rather than those of readers with model-making tendencies, had reduced the drawings to fit the page so to speak.

Moral—when working from drawings in such books check the scales *before* you start.

For the Bookshelf

How to Build a Model Racing Car. No. 1, The Monoposto Alfa Romeo type B. By C. Posthumus (Motor Miniatures). Price 3s. 9d. Distributed by Percival Marshall & Co. Ltd., 23, Great Queen Street, London, W.C.2.

Those who desire to make a faithful replica of a racing car should buy this interesting little book, the work of one of the best known exponents of the scale solid model. Mr. Posthumus has drawn many sketches illustrating his methods of construction which will give a new slant on many constructional problems, and will interest the more experienced model-maker as well as the tyro.

Miniature Building Construction. By J. H. Ahern (London : Percival Marshall & Co. Ltd.). Price 8s. 6d. net.

For the keen model-maker who is not possessed of a lathe, small tools and the more usual workshop equipment, there is wide scope if the available materials are pieces of wood, card and paper, and the tools merely scissors, razor-blades and some old gramophone needles. With all these readily to hand, together with some glue or other good adhesive, the making of models of all kinds of buildings becomes an engrossing pastime ; and Mr. Ahern has written this book to show not only what to make, but how to make it. The subject is treated progressively in fifteen chapters extending to more than 150 pages. Considerable space is devoted to tools, materials and constructional methods, accompanied by numerous clear sketches specially drawn by the author to augment and amplify his instructions. The photographs and drawings of finished models are a delight in themselves, and they act as a strong incentive to the reader to try his hand at making the models shown. The range covered by this book is wide and varied, though by no means exhaustive ; but it sets out the basic ideas so fully that there should not be the slightest difficulty in modelling a building of any kind.

An Appendix consists of a series of pictorial drawings illustrating twelve different models designed by Mr. Ahern ; and, in connection with these, Messrs. Percival Marshall & Co. Ltd. can supply 4-mm. scale blueprints of all of them.

The British Journal Photographic Almanac, 1947. (London : Henry Greenwood & Co. Ltd., 24, Wellington Street, London, W.C.2.) Price 4s. (paper-board covers) ; 5s. (cloth bound), postage 6d.

Every photographer, both amateur and professional, will welcome the latest edition of this hardy annual, now in its 88th year of publication. It contains, as usual, the latest information on photographic processes and formulae, reviews of new apparatus and materials, a glossary of photographic and chemical terms, and the pictorial art supplement, comprising examples of the most outstanding photographs of the past year. Special articles include : " Photography and the Visual Arts," by the Editors ; " The Camera in Ireland," by Hallam Ashley, F.R.P.S. ; " Medical Photography," by L. B. Bourne, M.R.C.S. ; " Emulsion Sensitivity and Contrast," by Richard B. Willcock ; " Frost, Snow and Ice," by Edward Richardson, M.A., and " Photographic Old Masters," by T. F. Langlands.

WATCHING THE WHEELS GO ROUND

No. 1—The Electro-Mechanical Oscillograph

by H.C.W.

"WATCHING the wheels go round" describes one of the main attractions of model engineering. There is little doubt that to the average model engineer, steam holds more attraction than electricity for the very reason that with steam he can see how everything works. It is a simple matter to turn the engine over slowly and observe the operation of the most complex valve-gear and to decide in exactly which order the various series of events is taking place. The same thing holds good to a large extent with the I.C. engine.

With electrical machines, however, so much has usually to be taken for granted by the model engineer. For example, power-factor, lead, lag and waveform are not things that can normally be seen, but I shall hope to show that it is quite possible to make things visible in the electrical field, and even to find out exactly what is happening, in a way that can make electrical machines more attractively interesting even than their steam counterparts.

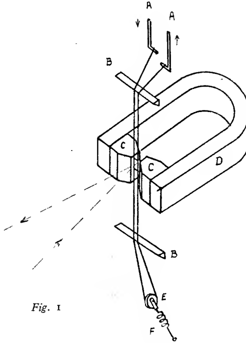


Fig. 1

The tool which the electrical engineer uses for this purpose is the oscillograph, and the earliest form, perfected by Duddell, is by no means beyond the scope of the average mechanic.

The Duddell oscillograph, in principle, consists of a mirror galvanometer with only two wires, instead of the usual coil, in suspension between the pole-pieces of a permanent magnet. When direct current is passed through the wires of the suspension, one will be deflected forward and the other backward, thus giving a horizontal twist to the small mirror which is fixed to their centre. Reversing the current will, of course, deflect the mirror in the opposite direction. The deflection is always against the tension of the wires, which is maintained by a spring through a small insulated pulley at the bottom.

The general arrangement is shown diagrammatically in Fig. 1, where AA are the two terminal wires to which the suspension is soldered, BB are the two insulating bridge-pieces over which the suspension is held in tension by the spring F and insulated pulley E.

The suspension wire is often in the form of a small strip about 0.006 in. $\times$ 0.0004 in., made of phosphor-bronze for strength. It must, of course, be non-magnetic. The mirror is extremely small, being about 0.06 in. $\times$ 0.02 in., and it is stuck to

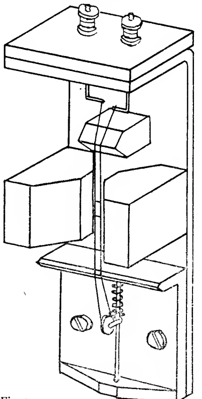


Fig. 2

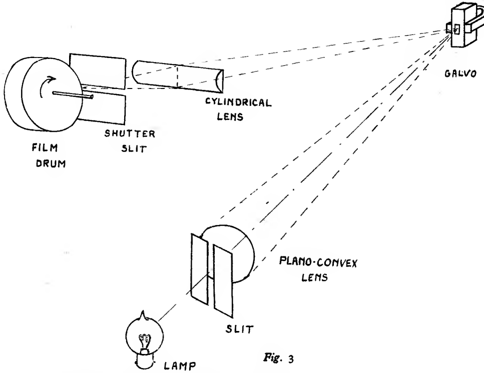


Fig. 3

the centre of the suspension with a microscopic dab of thin shellac. In order to avoid the suspension resonating at its own natural frequency, it is usually immersed in an outer case containing glycerin and having a small glass window opposite the mirror.

The general layout of the oscillograph galvo. movement is shown in Fig. 2, in which the pole-pieces are shown attached to the brass back-plate and the permanent magnet has been removed for clarity.

Optical System

In use, the mirror is made to deflect a beam of light from side to side on a photographic film or strip of bromide paper. The arrangement is shown in Fig. 3, and it will be seen that an electric lamp is used to illuminate an adjustable slit. The

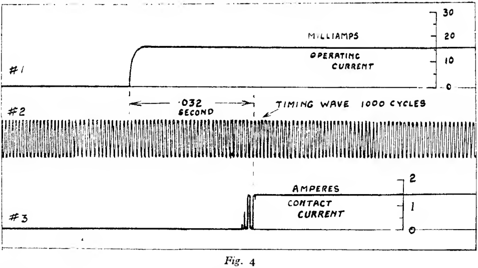


Fig. 4

image of this slit is reflected by the mirror and brought to a focus by the plano-convex lens, in front of the cylindrical lens. There it would appear as a vertical line of light, and this is brought down to a spot at the surface of the photographic paper by the cylindrical lens. The paper is attached to a drum in a light-tight box, which is driven by a small electric motor. When the record is to be taken the shutter is opened by an electrical relay for exactly one revolution of the drum and then closes. The trace on the paper will be a faithful record of the waveform of the current flowing in the suspension wires.

It is quite possible to record several waveforms at the same time by having more than one galvo.; each one will be arranged to reflect its spot of light to a different part of the film and it is necessary to ensure that the separate traces do not overlap too much and so produce confusion in the final result.

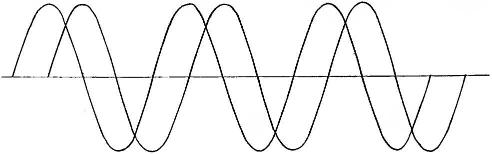


Fig. 5

Uses of the Duddell Oscillograph

This type of oscillograph is used mostly for investigation on low frequencies such as those used on power supply mains, though special types are often used to record audio frequencies used in speech—indeed, more than one of the types of sound-track recording for cinematographic work use the Duddell type of galvanometer with a simpler type of optical system.

It is very useful for timing operations when several light beams are being recorded at the same time. For example, in ballistics it may be necessary to measure the time taken for the charge to expel a bullet from a gun and also the final speed of the bullet. This would be done by arranging for the hammer of the gun to complete the circuit to one galvo. when it struck the cap of the cartridge. Another galvo. circuit would be interrupted by a wire being severed by the bullet as it left the muzzle of the gun. Another similar wire would be broken at a known distance away and would break the current flowing in the third galvo. A fourth galvo. might carry an alternating current of some known frequency for use as a timing wave so that the time between the three events could be measured.

Fig. 4 is a sample oscillogram showing the time of operation of a relay. In this case galvo. No. 1 carries the operating current in the relay coil, and it will be seen that the initial rise of current is rounded off, caused by the inductance of the relay windings. Galvo. No. 2 carries a 1,000-cycle per second timing wave. Galvo. No. 3 carries the current in the contacts and one can see that the contacts have a tendency to bounce as they make contact instead of closing sharply. By counting the number of cycles in the timing wave we find that it took the relay 0.032 sec. after the current was applied before the contacts closed.

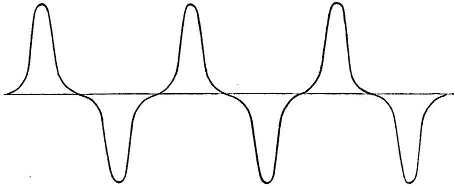


Fig. 6

It is used also for studying the waveforms of alternators and electrical machines generally. Fig. 5 shows an alternating wave of the supply mains with another one following it and lagging on the first by 90 deg. Fig. 6 shows a supply waveform distorted by a very pronounced third

harmonic. Fig. 7 is the waveform of the human voice (male) singing a long-drawn-out "Ah."

A simple, home-made oscillograph galvo. can be constructed from an old telephone ear-piece of the "reed" type by fixing a small piece of fairly stout rubber between the end of the reed and a bracket attached to the case, and sticking a small mirror to the rubber with shellac. The result will not be an instrument that will faithfully reproduce all frequencies in the audio range, because of the natural resonance of the relatively heavy moving parts; but it will serve the purpose as far as accurate timing and fairly low frequencies are concerned.

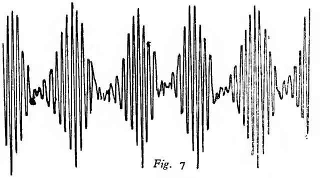


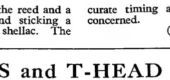
Fig. 7

(*To be continued*)

T-SLOTS and T-HEAD BOLTS

REFERRING to discussion which took place in the columns of THE MODEL ENGINEER some time back on the subject of post-war supplies for model engineers, here are a few suggestions based on experience (bitter!).

First, that the dimensions of T-slots in small machine tables (including slides of small lathes) should be standardised (to suit T-head bolts as recommended below or other standard dimensions).



Second, that these slots should be machined on all faces, or at least cleaned up to pass standard T-bolts without obstruction.

Third, that a minimum lip-depth of $\frac{1}{4}$ in. should be given to T-slots, making the space for the heads of the T-bolts shallow rather than the lips if available depth of metal is limited. I suggest as standard (*minima*):—

Overall depth of slot	$\frac{3}{8}$ in. full.
Width between lips	$\frac{3}{8}$ in.
Depth of lips	$\frac{1}{4}$ in.
Width (bolt-head space) ..	$\frac{5}{8}$ in.

Fourth, that in all possible cases a standard spacing apart of T-slots—I suggest $1\frac{3}{8}$-in. centres—should be used. It would be a manifest convenience to the worker to be able to use same "straps" or straddling pieces or standard spacing of drilled holes in fixtures, rather than to have to provide several sets to suit varying slot-spacings. Inspection of a variety of machines goes to show that the $1\frac{3}{8}$-in. spacing and other above recommended standard dimensions could be adopted without undue structural weakening. Incidentally, this spacing would enable the number of slots in the cross-slide of the average small lathe to be increased by one with some advantage in setting up boring jobs, etc.

Fifth, that T-bolts, having standard heads and varying lengths to suit work—I suggest 1 in. to 6 in., advancing by increments of 1 in., each size screwed one-third of its length—should be a stock item, and that these (together with nuts to match) should be of steel of a quality which will stand repeated pulling up tight without deformation of heads or screw threads. For single-bolt fixing, e.g., of lathe top slides, or mounting vertical slides by means of one or two bolts, the bolt shanks could be of $\frac{3}{8}$-in. size throughout, but the bolts supplied for work-mounting purposes, while having $\frac{3}{8}$-in. square under head, might have $\frac{5}{16}$-in. shanks. For the latter purpose, bolts with $\frac{3}{8}$-in. stems are rather bulky and necessitate the use of correspondingly bulky clamping pieces. Those having $\frac{3}{8}$-in. stems need only be supplied in 1 in. and 2 in. lengths.

Sixth, that the holes or slots in the bases of vertical slides, etc., should not exceed $\frac{3}{8}$ in. in diameter or width.

I have a vertical slide by a well-known maker of a size, designed (according to his own catalogue) for use with 3-in.-$3\frac{1}{2}$-in. lathes. It is admirably made in all respects, but one, namely, that *the slot in base for bolting it down is $\frac{5}{8}$ in. wide*. Result, smashed T-slot in lathe carriage and that without tightening bolt to any greater extent than required for essential rigidity in a lathe-milling job.

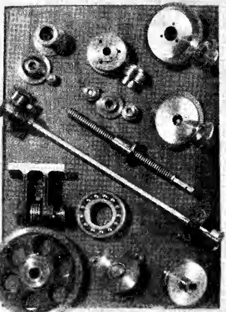
The only safe way—as no doubt I should have anticipated, and as this bitter experience has shown—of using this slide in the lathe, is to interpose between its base and the lathe slide a stout and truly parallel-faced steel plate. Otherwise the whole stress is borne by the lips of the T-slot, the unnecessary width of slot in base of vertical slide (shown black in sketch herewith) being the cause of the trouble. Has anyone ever had recourse to $\frac{5}{8}$-in. bolts for mounting such an attachment in ordinary use?

These remarks apply, of course, only to lathes of 4-in. centres height and under, and to other machines and attachments in the same general size category.—N. McNEILL.

Instrument Gears and Components

A LARGE and widely varied selection of gears and other components, taken from calculating, plotting and integrating instruments, has recently been offered for sale by Educational Models Ltd., 34, Twickenham Road, Teddington, Middlesex. We have examined samples of these components, which include several sizes of bevel, worm, spiral and spur gears, in steel and phosphor bronze, couplings, dog clutches, ball races and housings, and shafts. The gears range in size from about $\frac{1}{2}$ in. diameter to 4 in. diameter, and are all very accurately cut, many of them being entirely new and unused. They are cut to standard pitches, and include many meshing combinations, so that trains of gearing, such as complete spur or bevel differential gears, may be readily made up.

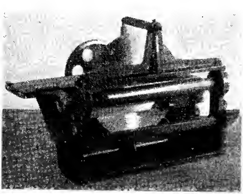
Some of the assemblies from these instruments present interesting possibilities from the point of view of the model engineer or experimenter. One item, for instance, comprises a complete variable-speed friction transmission gear, giving an infinitely variable range of speed in both directions of rotation, by the use of a disc driving a roller at right angles, through steel balls interposed between them, in a housing which can be moved across the face of the disc. A part of this assembly may be adapted without difficulty to make a very useful disc grinder for the workshop; while the disc alone, which is hardened and precision ground, would, if mounted on a base, make a handy surface plate for small work.



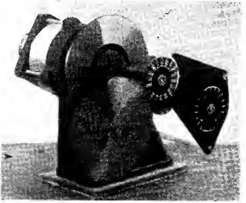
A selection of gears and other instrument components by Educational Models Ltd.

Another item of interest is a slip transmission motor unit, intended for the remote control of dial settings by electrical means. The actuating devices, both at the transmitting and receiving ends, resemble electric motors in their main essentials, having wound field-coils and armatures, but no commutators; slip-rings being used to convey current to the armature. In view of the accurate and robust construction of these components, the shafts of which are fitted with ball bearings, they would be worth rewinding or otherwise adapting for use as fractional h.p. motors for running on a.c. or d.c. supply.

All these items are offered at very attractive prices, and inspection of them is invited by the firm in question. In view of the constant demand among model engineers for gears of all kinds, it is anticipated that they will fill a long-felt want. We suggest that readers enquiring by post for gears to suit a particular purpose should give exact details of the sizes and ratios required, to avoid confusion or needless correspondence as to what is or is not available.



Complete variable-speed friction transmission gear



Remote-control dial setting transmitter unit

QUERIES and REPLIES

Enquiries from readers, either on technical matters directly connected with model engineering, or referring to supplies or trade services, are dealt with in this department. Each letter must be accompanied by a stamped, addressed envelope, and addressed "Queries and Service," THE MODEL ENGINEER, 23, Great Queen Street, London, W.C.2.

Queries of a practical character, within the scope of this journal, and capable of being dealt with in a brief reply, will be answered free of charge.

More involved technical queries, requiring special investigation or research, will be dealt with according to their general interest to readers, possibly by a short explanatory article in an early issue. In some cases, the letters may be published, inviting the assistance of other readers.

Where the technical information required involves the services of a specialist, or outside consultant, a fee may be charged depending upon the time and trouble involved. The amount estimated will be quoted before dealing with the query.

Only one general subject can be dealt with in a single query, but subdivision of its details into not more than five separate questions is permissible. In no case can purely hypothetical queries, such as examination questions, be considered as within the scope of this service.

PLEASE!

We must impress upon readers seeking information relating to electric motors that it is always necessary to give full details of the machine as follows:

1. **Diameter and length of armature.**
2. **Number of slots in the armature.**
3. **Width and depth of the slots with a sketch of shape of the slots enabling the space available for coils to be calculated.**
4. **Whether the slots are parallel with the shaft or at an angle to it. (Skewed.)**
5. **Number of commutator bars.**
6. **Dimensions of field poles.**
7. **Whether the whole field system is laminated or the poles only.**

Where information regarding transformers is required, size of the laminations should be given together with the core area, (cross-sectional) and depth of stack.

No. 8031.—Trouble with Petrol Blow-lamp. L.T. (Shallufa)

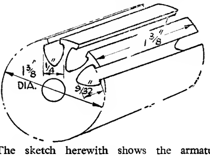
Q.—In building the "Javelin" T.B.D. from the series of articles in THE MODEL ENGINEER, I have made a reasonably successful petrol blow-lamp, but it continually chokes after about five minutes' running. Is this usual? Also, the flame tube becomes red hot. It seems to me to be rather unsafe and I should hate to see the finished boat go up—or down—in smoke.

R.—The blow-lamp flame tube usually runs red hot and if the bilges of the boat are kept free from leaking fuel, there should be no danger in this. The choking is due either to impurities in the fuel or scale in the fuel pipe. To clear the latter, you could make the tube red hot and then quickly pour cold water through it, repeating the process two or three times. This loosens the scale and washes it out. For impurities in the fuel, a finer filter is indicated.

No. 8028.—Converting a 24-volt Motor. L.B. (Kidderminster)

Q.—I have a 20-volt electric motor with 22 commutator segments and 11 armature slots. I wish to use this motor on the lathe tool-rest for grinding a 30-c.c. cylinder liner.

What would be the gauge of wire and how many turns to convert this into a 230-volt machine? Would 230 volts be too much for safe commutation?



The sketch herewith shows the armature diameter and slot dimensions.

R.—A suitable winding for the suggested conversion will be, for the armature 78 turns per coiled section of 38 s.w.g., enamel single silk-covered copper wire. If there are 11 slots, there will be 11 coils, each coil having two sections, so you will have 11 coils or 22 sections.

Commence wiring in slots 1 and 6, and so on around the armature. Wind on the first section, bring out a loop, wind on another section and you have the first coil (a two-section one) wound. Follow on in the next pair of slots in the same manner until the armature is completely wound. Insulation may be 5 mil. Leatheroid.

For the fi ld-coils, each coil should have 350 turns per coil of 34 s.w.g. plain enamelled or enamelled single silk-covered wire.

The speed of the motor will be in the region of 8,000 to 10,000 r.p.m.

No. 8030.—Material for Ribs and Deck Beams for a Model "Javelin." A.B. (London)

Q.—I wish to build a model of the T.B.D. "Javelin" as described in the recent series of articles in THE MODEL ENGINEER, but so far have been unable to procure suitable material for the ribs and deck beams.

R.—One of the builders of the "Javelin" solved this problem by purchasing lengths of brass curtain runner from the ever-useful Woolworth's Stores. The section was about $\frac{3}{4}$ in. deep with the upper flange, which was about $\frac{1}{4}$ in. wide, formed symmetrically on the web, and the lower-flanged formed on one side only. When the central portion of the web was cut away the upper flange formed a T-section for the ribs and the lower flange an L-section for the deck beams. The portion cut away which was a strip about $\frac{1}{4}$ in. wide also came in very useful.

Editor's Correspondence

Fluorescent Lighting

DEAR SIR,—I was very interested to read the article in THE MODEL ENGINEER, May 15th, on fluorescent lighting, but feel that the following additional information would be essential to amateurs.

It should be stated that these lamps for the time being only work satisfactorily on alternating current. The inference given from reading the article is, of course, obvious (to an electrician).

With regard to the question of the manufacture of a choke suitable for this type of lamp, this is not quite so easy as H.C.W. states. When the lamp is switched on, the lamp voltage is somewhere about 20 volts, and the current passing depends on the impedance of the choke. The use of higher starting currents must be avoided; also, if the current is too low, the time taken to obtain full brilliance may be longer. Care must be taken to design the choke by using the proper gauge of wire and core to be safe from overheating which may arise. Also, the total wattage dissipation should not be more than 10 watts. Again, unless care is taken, considerable vibratory noises in tone sympathy with the periodicity of the supply may occur, with consequential nuisance.

Regarding the hand operation of the starting switch, this method is very inconvenient, and is not to be recommended. A further point to be borne in mind, which was not mentioned, is the stroboscopic effect (due to the no volt period of alternating current) which may produce stationary images of any moving objects which it illuminates. While this may be useful for examining machinery in motion, for ordinary purposes the flicker effect can be very objectionable. This can be overcome to a certain extent if more than one lamp is used on a 3-phase supply. Recent research has reduced this effect to a certain extent by embodying "after glow" effect, which maintains a certain amount of illumination during the no volt periods of the supply.

Yours faithfully,

Brighton. S. R. BOSTEL.

DEAR SIR,—In reply to your correspondent, Mr. Bostel, I would confirm that these lamps are only suitable for use on a.c.

Regarding the design of the choke, it is advisable that the current at starting will be higher than when the tube has warmed up. It must not, of course, be sufficiently high to damage the tube, and if the instructions given in the article are adhered to, it will be found that the impedance value to limit the current to the required value when hot, will also keep it within safe limits on starting. Any vibratory noises are the result of loose punchings in the core and the remedy is to pack them in tighter or paint the core with shellac to make it more solid.

I would agree absolutely that the hand-starting switch is far from convenient and that it would be much more satisfactory to buy the complete equipment from the manufacturer and have it installed by a competent electrician. There happen, however, to be some in our fraternity who, for some unknown reason, like to tinker around with these things for themselves. They have my sympathy, for I am one of their number, and it was for their benefit that the details of construction were given.

Regarding the alleged stroboscopic effect, it is not my experience that this is at all serious, such, for example, as to lead one to catch hold of the chuck while it was doing 1,000 revs. under the impression that it was stopped! It seems, moreover, with these lamps that there is more change of colour over the cycle than intensity, giving rise to a slight stroboscopic rainbow reflected in the side faces of the rotating chuck jaws. I think, perhaps, your correspondent's experience has been limited to the "bulbular" type, partially corrected mercury vapour lamps, which have a greater stroboscopic effect than the tubular variety.

Yours faithfully,

H. C. W.

The Tandem Compound Engine

DEAR SIR,—In the description of the "Tandem Compound Engine," in THE MODEL ENGINEER for May 22nd, your contributor, "Crank Head" states that as he was unable to increase the size of the air pump to get increased capacity it was necessary for him to make it double-acting.

The type of pump he describes for this is certainly double-acting, *but it has no greater capacity than a single-acting pump of similar size*, as it is of the Bucket and Plunger type.

In this type of pump half the capacity of the barrel should be delivered on the up stroke and half on the down; incidentally, in the example illustrated, owing to the plunger or trunk being of too small a diameter—its area should be half that of the pump barrel—it would deliver about three-quarters of the contents of the pump barrel on the up stroke and about a quarter on the down.

In order to make it double-acting *and of double the capacity* the piston would have to be valve-less and there would need to be a suction and delivery connection, each with valves *to both ends* of the pump barrel.

A single-acting pump will deliver *one* pump-barrel-full per revolution, and that is precisely all that the same sized Bucket and Plunger type pump will do.

Yours faithfully,

Streatham. W. B. HART.